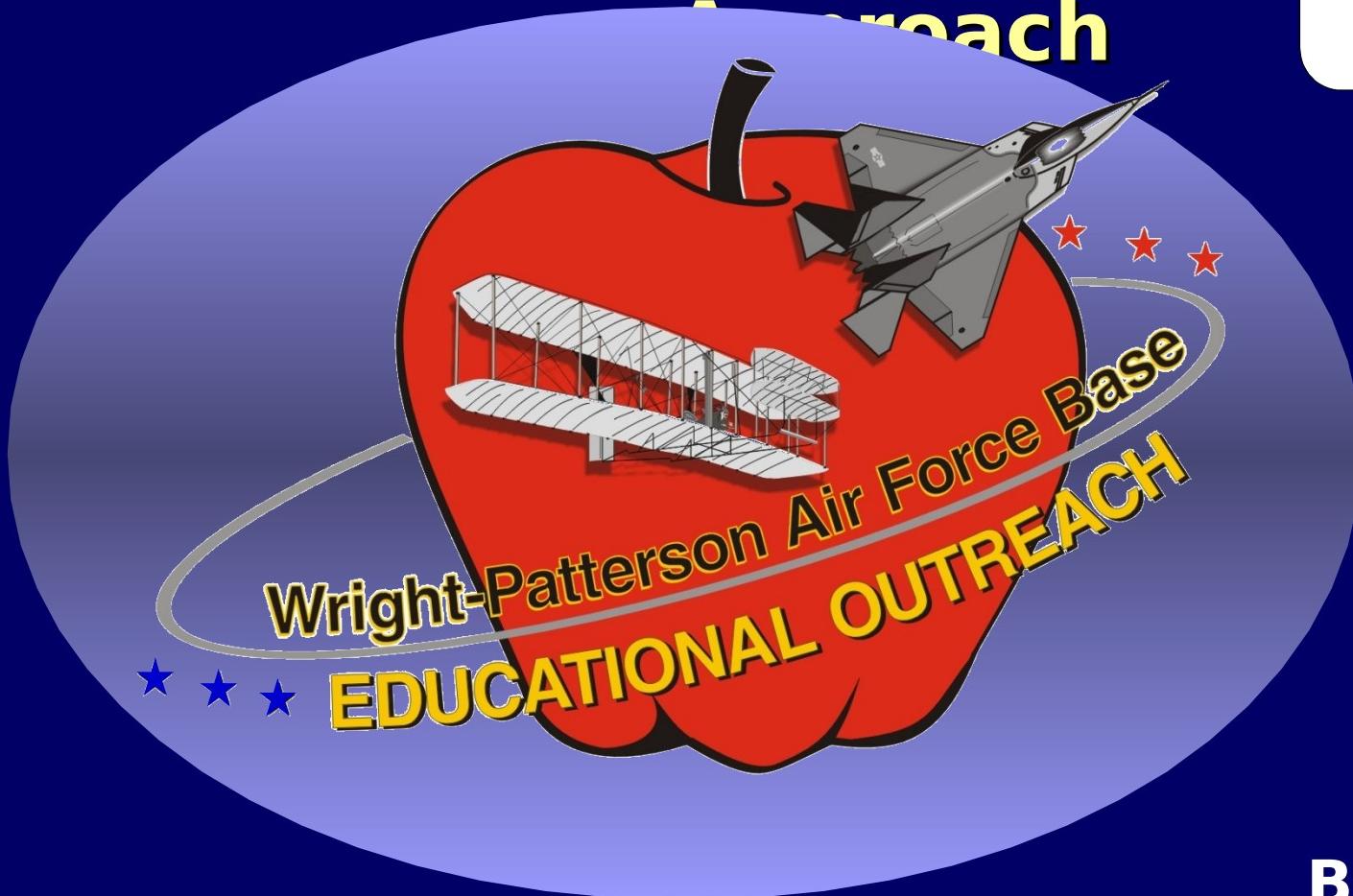


Participating in Science & Engineering Fairs - A Practical Approach



<http://edoutreach.wpafb.mil>

Bob Gemin
WPAFB Educational Outreach
Engineering
Specialist



**When Somebody
Says "Science
Fair" What's The
First Thought That
Pops Into Your
Head??**



A Science Fair Is...



If You're A Teacher:

- **A Tool**
- **Something To Grade On**
- **A Creative Outlet for Students**

If You're A Parent:

- **Stressful...it's a PAIN!!**
- **Conflicts...Helplessness**
- **Potential Source of Pride**

If You're A Student

- **A Requirement For A Grade**
- **More Work!!**
- **Too Many Decisions!!!**
- **Fear Of Unknown**

What SHOULD You Think Of?



How You Will Feel After Participating In The Science Fair

- Pride...Not Relief!
- Rewarded...Not Punished!
- Reward is an Honorable Goal!!
- Motivator Doesn't Always Have To Be Grades!



***If It Motivates You...
Work for the
Rewards!!!***

***The Important
Results Will Be***

A Science Fair Project Is An Opportunity!!

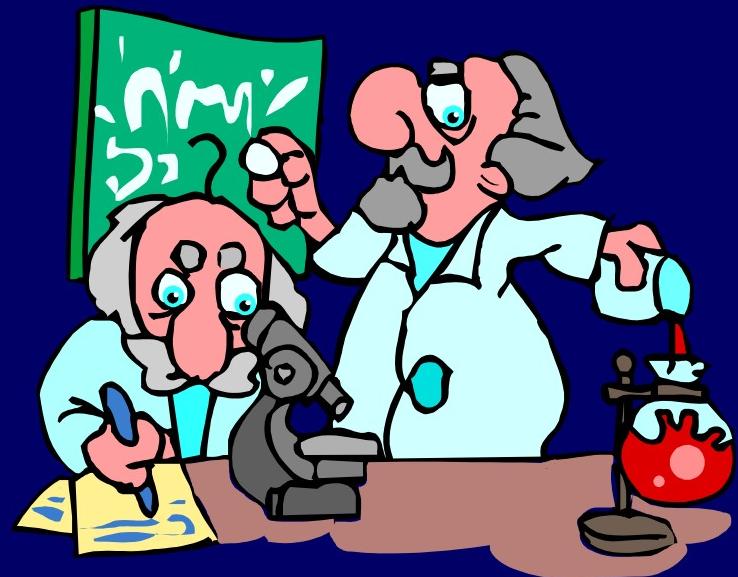


Lots of Awards!

- Prizes
- Money
- Scholarships
- Summer Jobs
- Entry Into Select Colleges

By Products:

- Organization Skills
- Critical Thinking Skills
 - Quote Facts, Not Hearsay
- Presentation Skills
- Sense of Self



The “Recipe” For A Classic Science Fair



If You've Never “Cooked” Before,
There's A Lot Involved in Baking A Cake!!



Preparation:

- Do You Have All The Ingredients You Need?
- Do You Have All Right Tools?

Process:

- Follow The Recipe
- Do Things Step-By-Step
- Leave the Fancy Stuff to the Chefs!!

The Science Fair Recipe



QUESTION

RESEARC

HYPOTHESIS

PROCEDURE

EXPERIMENT

RESULTS

ANALYSIS

CONCLUSION



Scientific Method

Question - Tailor Your Project To You!!



Consider Your

- Interests
- Knowledge Base
- Access to Mentors
- Available Equipment
- Natural Surroundings

Make A List of Each

- Look For Matches Between Rows



STEP #1 - QUESTION

Take A Good Look At Your List!



INTERESTS	KNOWLEDGE/ SKILLS	MENTOR	EQUIPMENT/ SURROUNDING
BASKETBALL	MATH	MARY - CHEMISTRY	RULERS
COMPUTER	COMPUTER GAMES	JIM - GARDENING	SCALES (BATH, FOOD, POSTAL)
BUILDING	DRIBBLING BASKETBALL	BOB - ELECTRONICS	THERMOMETERS
LEGOS	BUILDING THINGS	JANE - MECH ENG	FISH TANK
SWIMMING		BETTY - NURSE	BLOOD PRESSURE MONITOR
BIKING		ROY - PAINTER	STOP WATCH
MEDICINE			VIDEO CAMERA
			LEVEL
			RUBBER BANDS
			PRESSURE GAUGES

STEP #1 - QUESTION

**I Like Basketball, Roy Has
Ladders, I have Pressure
Gauges...I Wonder How High a
Basketball Will Bounce Under
Different Pressures?**



INTERESTS	KNOWLEDGE/ SKILLS	MENTOR	EQUIPMENT/ SURROUNDING
BASKETBALL			
COMPUTER	COMPUTER GAMES		SCALES (BATH, FOOD, POSTAL)
	DRIBBLING BASKETBALL		
LEGOS	BUILDING THINGS	JANE - MECH ENG	
		BETTY - NURSE	BLOOD PRESSURE MONITOR
MEDICINE		ROY - PAINTER	PRESSURE GAUGES

STEP #1 - QUESTION



*I Like Computers and Medicine.
I'm Good at Computer Games.
My Friend Betty is a Nurse and
Has a Blood Pressure Monitor.
I Wonder If Playing Computer
Games Raises Your Blood
Pressure?*

INTERESTS	KNOWLEDGE/ SKILLS	MENTOR	EQUIPMENT/ SURROUNDING
BASKETBALL	COMPUTER GAMES DRIBBLING BASKETBALL		SCALES (BATH, FOOD, POSTAL)
LEGOS	BUILDING THINGS	JANE - MECH ENG	
MEDICINE		BETTY - NURSE	BLOOD PRESSURE MONITOR
		ROY - PAINTER	PRESSURE GAUGES

STEP #1 - QUESTION

Question - Developing the Best Question For You

Websites To Spark Ideas:

- <http://www.stemnet.nf.ca/sciencefairs/>
- <http://www.scifair.org/ideas/index.shtml>
- http://www.dwusciencetfair.com/science_project_links.php3
- http://madsci.org/MS_search.html
- <http://youth.net/nsrsc/sci/sci.index.html>
- <http://ipl.org/div/kidspace/projectguide/projects.html>

- <http://scitoys.com/>



**Note: This Does NOT Constitute
An Endorsement of These
Websites**

Research - Get A Notebook!



- **Make A Commitment To Document Your Work**
- **Research Underlying Scientific Principles:**
 - **To Help Make Educated Guess To Answer Your Question**
 - **To Define the Test Design**
- **Internet Searches Are Great... But Don't Forget Books and People!!**
 - **More on This Later!!**

Hypothesis



- **The Hypothesis Rewords Your Question In A Way To Help You Do Your Test**
 - **Predict the Answer, State Your Reason, If Possible**
 - **Select Projects With Well Formed Hypothesis**
- **Special Cases - Engineering Projects**
 - **Recommendation: Always Have Hypothesis Listed On Poster Board, Regardless of Its Quality**

Hypothesis-Basketball Example:



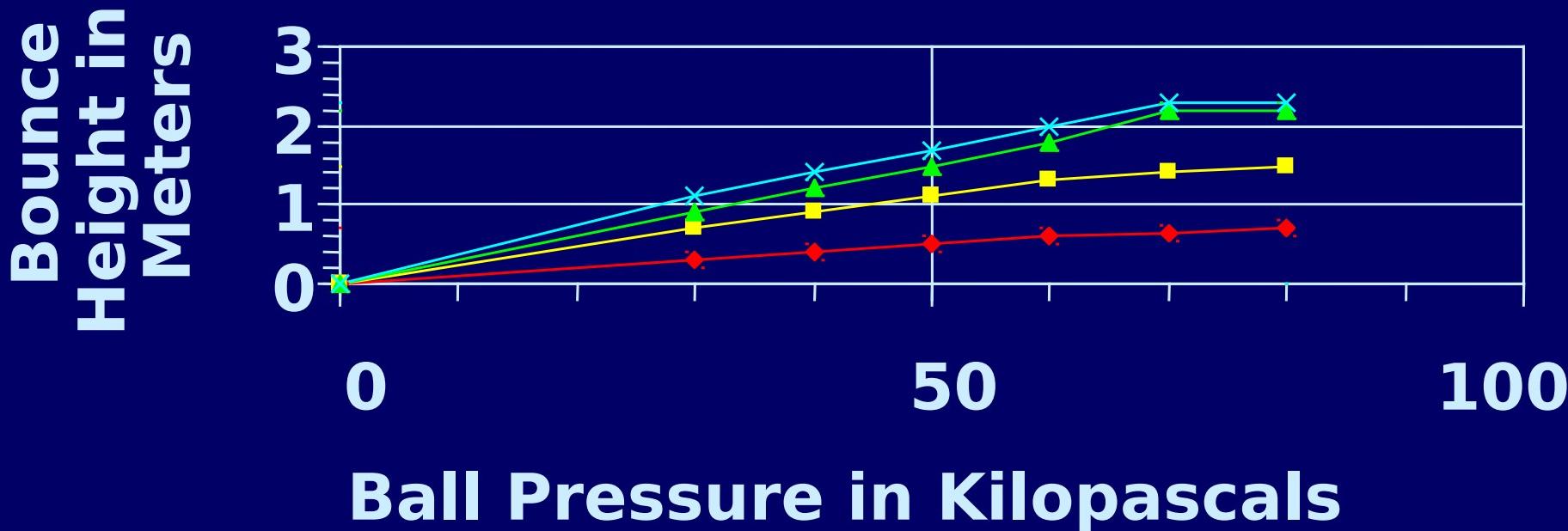
- I'm Going to Drop My Basketball With Different Air Pressures... What Do I Think Is Going to Happen?
- My Hypothesis: I Expect That My Basketball Will Bounce Higher At Higher Air Pressure
 - A "Plus" Would Be To Speculate "WHY?"
- Then, Start To Visualize Your Graphs That Will Answer Your Question



Thinking of Your Ultimate Product, Your Graph, Focuses Your Plan

Bounce Height for Various Basketball Pressures and Drop

—♦— 1 Meter Height —●— 2 Meter —▲— 3 Meter —×— 4 Meter



Procedure/Experiment - Design Is Critical



- Experiments Should Result in Data That Can Be Displayed in a Graph
 - Imagine Steps to Gathering Data to Put Dots on Graph - That is Your Procedure
 - Remember That You Will Need To Record The Data...How Will That Data Arrive?
 - How Long Will Data Point Stay Valid?
 - What Measurement Tools Do You Need?
 - Video Camcorders Can Help Slow Time

Advice on Gathering Data:



- **Do A Control Group**
 - The ‘NORM’ You’ll Compare Your Data To
 - Design and Use Your Own Data Sheet
 - Perform Multiple Data Runs

- **Reduce Your Variables**
 - Change Only Those That Are Under Test... Keep EVERYTHING Else The Same
 - Document Anything That Might Have An Impact (Somebody Opened The Outside Door and Let Cold Air In... The Bounce of The Ball Changed...)



Sample Data Sheet (Basketball Example)



Ball Pressure _____ **Ball Bounce** _____

Day _____ **Time** _____ **Temperature** _____

Test # _____

Drop Height _____

Test At This Height/Pressure **1** **2** **3**
(Circle)

Rebound Height _____

Observations: (This Could Include Picture
Number, Any Problems Noted (Ball Hit a
Pebble), Etc.)

Results - Perform The Experiment



- **The Better You Plan, The Simpler The Test!**

- **Record All Testing - Even Failures**

- **Do A Control Group**
- **Record All Conditions**
- **Record Qualitative Data Like Noises/Smells**
- **Control Your Variables Except What is Under Test**
- **Record Measuring Tool And Units Of Data**
- **Label Each Data Run By Time Of Day**



STEP #6 - RESULTS Test Setup, If Possible

Analysis - Have No Fear!!



You Analyze The Data By Putting It in the Graph

- I Ask Questions of the Graph...Linear? Slope?
Intercept? Maximum? Minimum?**
- I Report any Interesting Answers**
- I Indicate Reproducibility of Data - Show
Multiple Runs on Graphs...or Use Statistics**
- I Use Different Graphs to Show Different
Features**
- I Spreadsheets Are Powerful Tools**
- I Don't Be Afraid To change Axis Of
Graph! Data Can Be Worked in a
Variety of Ways**



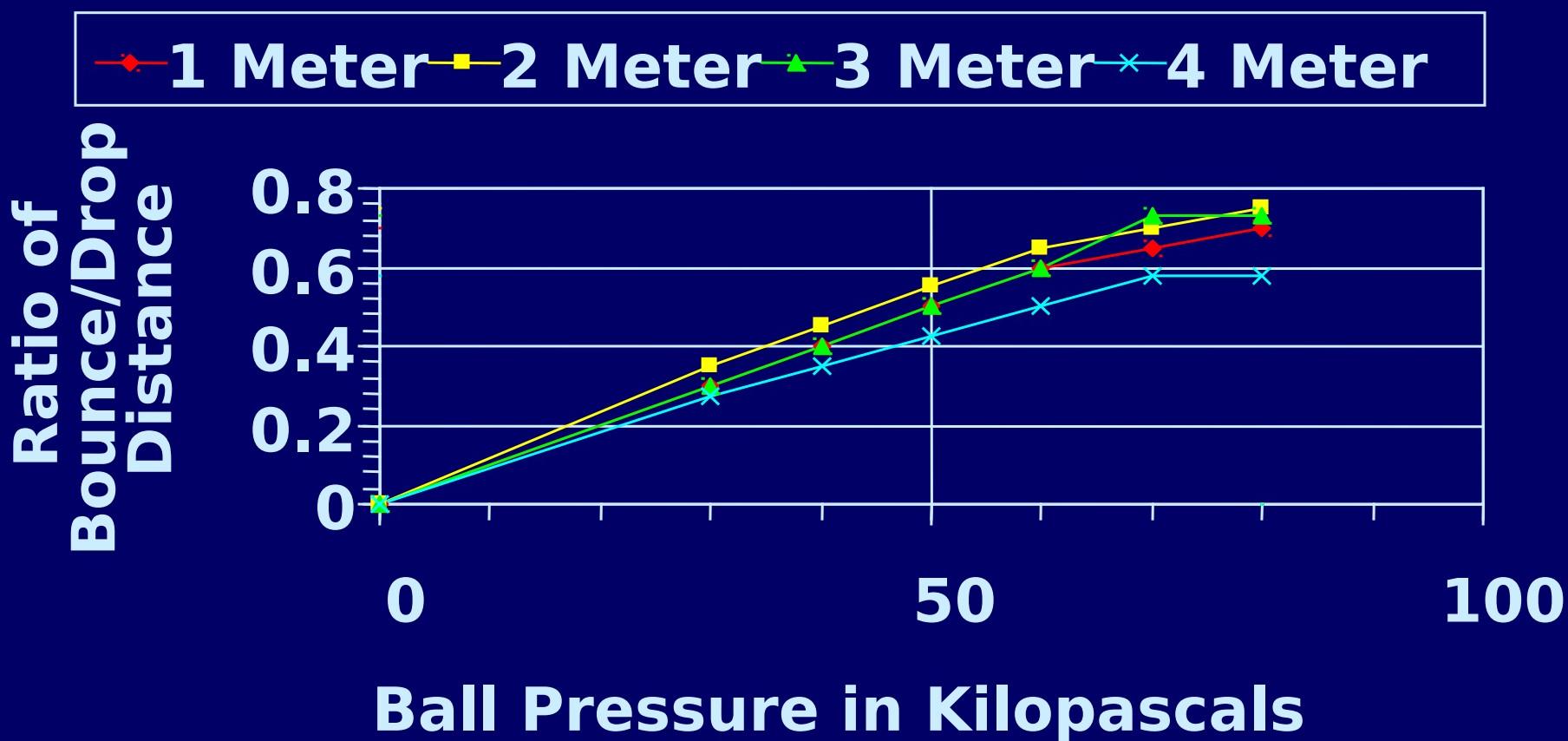
Back To Basketball...



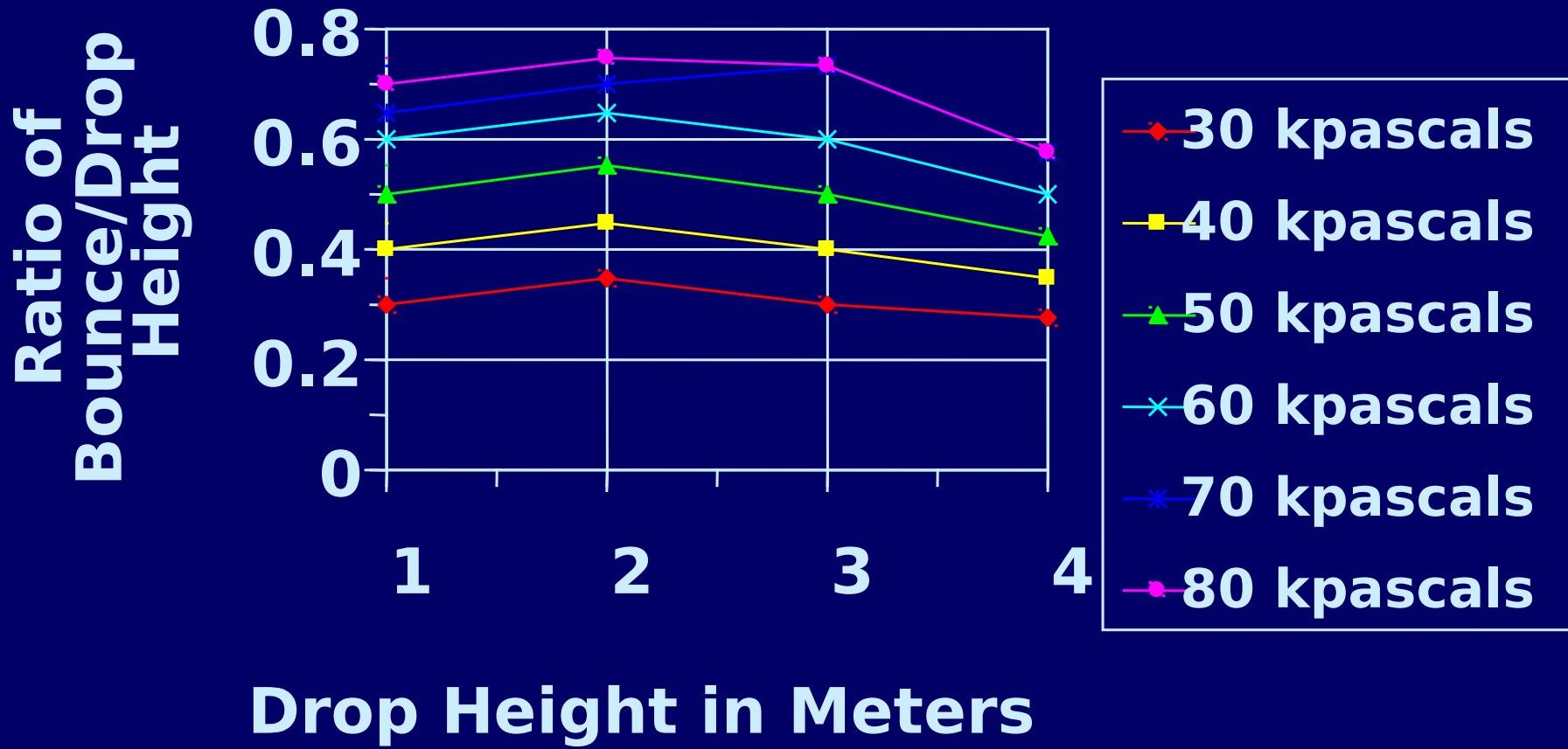
- Here Is Same Data In Two New Graphs Which Results In New Understanding
- This Is An Example Of Graphical Analysis



Bounce Ratio Versus Ball Pressure for Various Drop Heights



Bounce Ratio Versus Drop Height For Various Ball Pressures



Conclusion



- Your Conclusion is a Summary Focused On Answering Your Question/Hypothesis
 - If Your Hypothesis Was Incorrect or Disproved, It is NOT a Failed Experiment!
 - If Your Hypothesis Was Disproved, Offer An Alternative Explanation
 - Always Consider What More Could Be Done
 - Another Test
 - Another Project

How To Use “PEOPLE” In Your Research:



- You Can Have Numerous Mentors Based On Their Expertise!
- Start With Specific Questions
 - Tell Them What You're Doing and What You Think Will Work
 - Ask If You Can Ask Them More Questions
- Scientists and Engineers Love An Occasional Diversion...Like YOU!!
- Many Experts Can Be Found On the Internet
- Make Sure Your Parents Know!

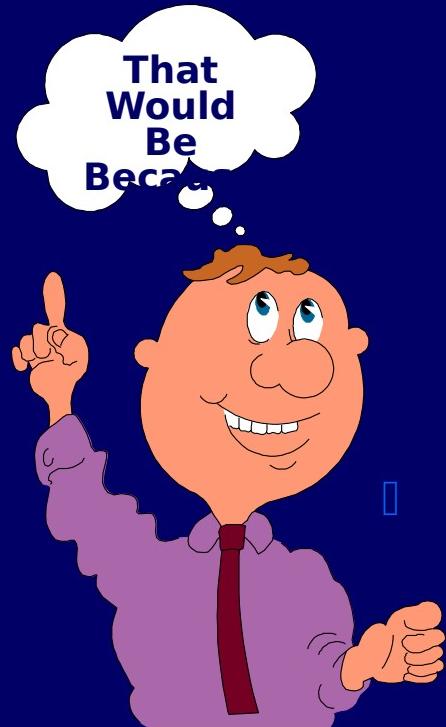


Checklist - What To Ask Yourself and/or Your Mentor

- How Do I Analyze?**
 - Use A Graph
 - Use Statistics
- How Much Data Should I Take?**
 - One Run Is Not Enough!
 - Do At Least Three (3)
- How Do I Define My Experiment?**
 - Start With Your Question
 - Envision Graphs That Answer Your Question
 - Envision Collecting Data to Put The “Dots” on the Page
 - Develop Data Sheet



Prepare For Presentation:



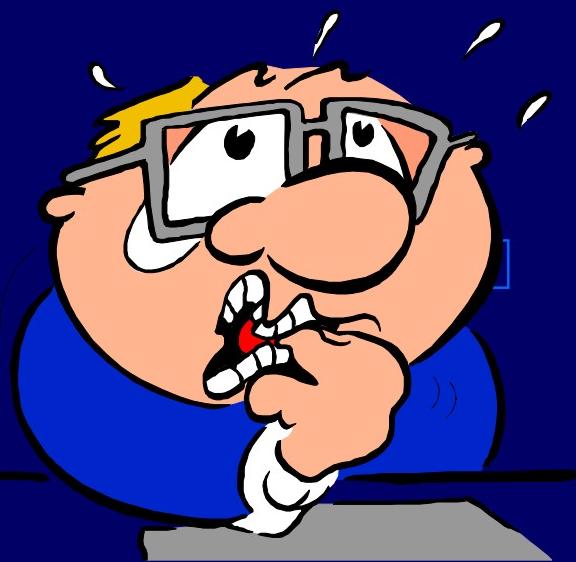
- The Focus Should Be Knowledge ... But In A Science Fair IMPRESS THE JUDGES!!
 - Anticipate Questions The Judge Will Ask
 - Research The Answer
 - Make Yourself A Note Card
 - Practice Reciting The Answer So It Sounds Natural
- Use your Poster As A Big Note Card
 - Use Topics/Key Words to Stimulate Discussion
 - Don't Forget to Explain Your Graph!!

NO FEAR!! **Practice Your Presentation**



- Use Flash Cards To Practice What You Want To Say**

- It Helps You With Things You Should Know Under Pressure (And Might Not Remember...)**
 - Anticipate Questions!**



- It Also Adds To Your Knowledge Base!**

Preparing For The Judges:



- Expect Questions
- Have Your Answers Ready For Expected Questions
- Work Your Answers In If Not Asked
- Make Sure You Provide Information in Judging Category:
 - Knowledge Achieved
 - Originality





Typical Questions:

- I Where did the idea for this project come from?**
- I What did you learn from your research?**
- I What were the most important sources used in your research?**
- I How much time did you spend on the project?
What took most of your time?**
- I Where did items used in your project come from?**
- I How many times did you run the experiment on each configuration?**
- I Did you use any statistics such as averaging?**
- I How constant were your conditions during experiments?**

Selling Yourself - Use PIE!



- **Performance**
- **Image**
- **Exposure**



- **Science Fairs Are A GREAT Time To Learn How To Promote Yourself**
- **Many Successful People Use PIE Principle**
- **“Performance” Already Covered**
- **Look At Image And Exposure...**

Image -

The Impression You Give in Appearance and

Actions:

- You Want The Judges To Relate To You And See Their History In YOUR Future!**
- Project The Image Of Being A Budding Scientist Or Engineer**
- Dress Like They Would Dress**
- Show Them You Enjoy What You're Doing...Tell Anecdotal Stories of What Happened, Extra Stuff You Learned**
- Ask Questions**
- Play To Their Expertise...Ask How You Could Do Better In The Next Fair**



Exposure -

Make Sure The Judges See You and Remember You:

- Use Attention Grabbing Displays and Posters**
 - Check the Rules!!!**

- For Maximum “Traffic”, Pick A Project Related To Today’s Public Concerns**
 - Understand the Issue, Consider Being an Advocate**
 - Examples: Global Warming, Acid Rain, Failed Levies, Pollution, Earthquake Protection, Water Purification, Security Devices, Genetically Altered Foods**



Motivation - Many Opportunities Await!



- That Future Exceptional Science and/or Engineering Student Can Be You!!
- Summer Jobs, Free Training, Camps and More Are Available Through Science Fairs!
- Places To Check:
 - Ohio Academy of Science
<http://www.ohiosci.org/>
 - International Science and Engineering Fair... Make Participation in this Fair Your Goal! <http://www.sciserv.org/isef/>

Motivation - Many Opportunities Await!



More Places To Check Out:

- **Junior Science and Humanities Symposium**
<http://www.biosciences.utoledo.edu/oishs/index.htm>
- **Science Talent Search**
<http://www.intel.com/education/sts/>
- **National Youth Science Camp**
<http://www.sciencecamp.org/>
- **National Gallery for America's Young Inventors**
<http://www.pafinc.com/gallery/index.htm>

IT REALLY WORKS!!!!

Did We Mention “Having Fun”? :

- People Throughout History Experimented with Science and Engineering “For Fun”
- Imagine Getting Paid For Doing Something You Enjoy Doing!!
- To Avoid Stress:
 - Start Your Project Early, Be Ready... then Kick Back and Enjoy!!



**I HOPE TO SEE YOU
IN SCIENCE AND EDUCATION THIS YEAR!**



For Additional Information

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te - <http://edoutreach.wpafb.af.mil>



Major Funding For the WPAFB Education al Outreach Program Is Provided By the Air Force Research Laboratory



Check Out Our “Scopes For Students” Program!!

**Thanks To A Grant
From The Armed
Forces
Communications and
Electronics
Association We Can
Loan You Specialized
Equipment to Use
With Your Science Fair
Project!!!**



“Scopes For Students”

- **Digital Oscilloscopes Help You Measure A Variety of Parameters In Your Experiment**
- **Measurements are Taken at Small Intervals so You Can Catch What Happens In An Instant!**
- **Data is Recorded in Files That Can Be Analyzed Using MS**
- **Instructions on Equipment Operation Are Provided’**



Types of Sensors:

- Accelerometers
- Barometers
- Conductivity Probe
- Current Probe
- Dual Range Force Sensor
- EKG Sensors
- Force Plate
- Gas Pressure Sensor
- Light Sensor
- Magnetic Field Sensor
- Microphone
- pH Sensor
- Relative Humidity
- Respiration Monitor Belt
- Temperature Probes
- Thermocouple
- UV Sensor
- Voltage